

REMARKS — General

By the above amendment, applicants have amended the claims to define the invention more particularly and distinctly so as to overcome the technical rejections and define the invention patentably over the prior art.

The Rejection Of The Claims Under 35 U.S.C § 112

The O.A. rejected claims 1-12 under 35 U.S.C § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicants canceled the claims 1-12 and wrote new claims 13-30. The limitations in the claims 1-12 are incorporated into the newly written claims 13-30 to more particularly define the invention in a patentable manner, according to the O.A.

Regarding claims 2, 3, and 10, the last O.A. noted that the phrase “for example” renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention.

Applicants did not use the phrase “for example” in the newly written claims according to the O.A., as now applicable to new claims 15, 16, and 22.

The last O.A. noted the limitation of “whereby the binary age categories can be any partition of the entire age spectrum into two groups” in claim 1 is vague and indefinite.

Applicants did not use the limitation of “whereby the binary age categories can be any partition of the entire age spectrum into two groups” in the newly written claims according to the O.A., as now applicable to new claim 13.

The last O.A. noted claim 1 is a method claim and the method claim cannot define an apparatus. According to the O.A., in the newly written claims, the method claims define the methods and the apparatus claims define the apparatus, as now applicable to new claims 13 and 22.

According to the O.A., in the newly written claims, applicants wrote the claim limitations to end with a semicolon.

Accordingly applicants request reconsideration of this rejection.

The Objection To The Claims

The O.A. noted that claims 5-8 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim.

According to the O.A., applicants did not use the phrase “a single or a plurality of classifiers” in the newly written claims, as now applicable to new claims 16 and 25.

Accordingly applicants request reconsideration of this objection.

The Rejection Of The Claims Under 35 U.S.C § 101

The O.A. noted that claim 9 is rejected under 35 U.S.C § 101 because the claimed invention is directed to non-statutory subject matter.

Applicants canceled the claim 9, according to the O.A.

The Rejection Of The Claims Under 35 U.S.C § 102

The O.A. rejected claims 1-4, and 9-12 under 35 U.S.C. 102(b) as being anticipated by Lobo et al. (US 5781650, referred to as “Lobo” herein).

Applicants amended the claims as follows.

The Rejection Of Claim 1 on Lobo Overcome

With respect to claim 1, claim 1 has been canceled and all of the limitations in claim 1 have been incorporated into the newly written claim 13 as limitations of the newly made independent claim to define patentably over the reference.

Applicants request reconsideration of the rejection, as now applicable to claim 13, for the following reasons:

- (1) Fundamental approaches of the image processing in Lobo are different from that of applicants. Representation of face region as direct pixel information or any representations obtained by transformation into other spaces by algebraic manipulation is clearly foreign to lobo.
- (2) Fundamental difference in the classification methodologies in Lobo and the applicants' current invention.

(3) Age categorization of people from the low-resolution facial images in applicants' present invention is foreign to Lobo.

(4) Automation ability in applicants' present invention is foreign to Lobo.

Representation Of Face Region As Direct Pixel Information Or Any Representations Obtained By Transformation Into Other Spaces By Algebraic Manipulation Is Clearly Foreign To Lobo

The step of "processing said face region to extract face features" in applicants' present invention has been further explained in the specification (Applicants, page 5, lines 6-7) where the step has been described as "The feature extraction module comprises of means for processing the face region to extract discriminating features by algebraic manipulation." Principal component analysis, gray-scale value of the image pixels and non negative matrix factorization are some of the methods that could be used for this feature extraction (Applicants, page 8, lines 9-12).

On the other hand the figures in Lobo (Lobo, figure 1A, sheet 1, item 100) mention the process of finding the face features and is further elaborated in other figures (Lobo, figure 2, sheet 3). In the second figure (Lobo, figure 2, sheet 3), Lobo indicates that finding facial features involves finding an oval to fit the face, finding the chin, eyes, mouth, nose, etc. These steps are further discussed in the patent specification (Lobo, column 4, line 17 - column 11, line 4) in the paragraph entitled "STEP 1: FIND FACIAL FEATURES". Nowhere in this description is there any mention of using the algebraic manipulation of the face image as a facial feature. The algebraic manipulation of the image described in this section (Lobo, column 4, lines 44-63) are image processing steps used to help in finding the chin, eyes, mouth etc. quoted as "The eye potential image is the potential image to assist finding the eye" (Lobo, column 4, lines 64-65).

The Hough Transform that is mentioned in the patent (Lobo, column 6, line 25) is also used to find the chin.

At no point does Lobo indicate using the direct pixel values or the algebraically modified face image directly for classification. It is also not obvious in Lobo how it would be possible to use direct image pixel values or algebraically modified image as face features. However, in the applicants' patent (Applicants, page 5, lines 6-9 and page 8, lines 9-12), the applicants have explicitly made a case for using the direct image pixel values or algebraically modified image as face features. Hence the face features as discussed in Lobo are completely dissimilar to that discussed in the applicants' patent.

Fundamental Difference In The Classification Methodologies In Lobo And Applicants'

Current Invention

In Lobo, the ratios obtained from the face features are used for age classification (Lobo, column 19, line 64 – column 23, line 35). Besides ratios, Lobo also used the wrinkle pattern test (Lobo, column 25, lines 17-61) in order to identify the faces of seniors. Thus one or multiple ratios and the wrinkle pattern test are used for age classification in Lobo. In the applicants' patent, the gray-scale pixel values of the face image or the algebraically manipulated face image is directly used for classification (Applicants, page 8, lines 9-12). In order to directly use the multidimensional image data or the algebraically transformed image data, sophisticated algorithms such as Support Vector Machines have to be used (Applicants, page 8, lines 16-19). In Lobo, however, one dimensional data in the form of ratios are used and hence the classification step involves simple thresholding as discussed in Lobo (Lobo, column 19, lines 32-47). From Lobo, it is not obvious

how it is possible to carry out age classification if only the direct pixel values or the algebraically manipulated face image is available. This novel method for age classification of a person's face has been discussed in applicants' present invention (Applicants, pages 6-10).

Age Categorization Of People From The Low-Resolution Facial Images In Applicants'

Present Invention Is Foreign To Lobo

In Lobo (Lobo, column 23, line 50- column 24, line 5), high resolution face images are needed in order to detect the wrinkles on the face. Applicants' present invention, however, can work even with low resolution (Applicants, page 5, lines 2-3) "This invention deals with the age categorization of people from their low-resolution facial images into two groups." The method as discussed in applicants' present invention can be used for carrying out age classification on low resolution images as it uses the algebraically manipulated face image for classification. Thus the methodology in applicants' present invention is not limited by the resolution of the face image.

Automation Ability In Applicants' Present Invention Is Foreign To Lobo

Also, the process as in Lobo is semi-automated, unlike the method discussed in the applicant's patent. In Lobo (Lobo, column 6, lines 40-41) we find "Determination of whether a chin is found is currently done by human visual inspection." As human intervention is needed in the "Find Facial Features" stage of the system, the system cannot be claimed to be completely automated. However, in the method discussed in our patent, humans are involved only during the training stage of the system when the faces needed to be labeled as belonging to a particular age category (Applicants, page 8, lines 2-4). However, once the classifier has been trained, no further human

involvement is needed and classification of any new face into a particular age category takes place in a completely automated manner.

The Dependent Claims Are a Fortiori Patentable Over Lobo

New dependent claims 14 to 21 incorporate all the subject matter of claim 13 and add additional subject matter, which makes them a fortiori and independently patentable over the reference.

Claim 14 further adds a step of processing the age category classification in real time.

Applicants' present invention can carry out the processing at the same rate as the rate of image capture, which is foreign to Lobo, as the methodology in Lobo assumes some manual intervention as discussed in Lobo (Lobo, column 6, lines 40-41).

Claim 15 further adds a step of applying algebraic space transformations for extracting said face features from the face region. Examples of the algebraic space transformations in applicants' present invention are given, including Principal Component Analysis, Non-negative Matrix Factorization or gray-scale values of the facial regions (Applicants, page 8, lines 9-12).

In applicants' present invention, the output of the face feature extraction stage is directly used for age classification depending on how the training set was created. The algebraic space transformations as used in the patent by Lobo, however, are used in order to detect the face features such as chin more accurately, as seen in Lobo (Lobo, figures 4 and 5) and described in Lobo (Lobo, column 5, lines 50-52), where the edge image potential is used to find the bottom of the chin.

Thus even though the methods as discussed in the claims are similar to those discussed in the patent by Lobo, the purpose behind each of the methods is completely dissimilar.

Claim 16 further adds a step of utilizing a plurality of classifiers for said binary age category identification. In Lobo, six different types of ratios were tested for age classification and in Lobo (Lobo, column 23, lines 42-48) it is mentioned that depending on the case such as “face rotated in depth”, different ratios could be used. Combination of multiple ratios by statistical analysis is also mentioned in Lobo. It is, however, not explicitly shown how the different ratios could be used in combination. On the other hand, applicants have indicated that multiple classifiers could be designed by varying the type of classification method used or the face feature used in (Applicants, page 9, lines 9-21).

It is not explicitly mentioned how it is possible to use multiple classifiers if ratios and the wrinkle pattern test are to be used for classification. Thus, the method in applicants’ present invention is completely novel compared to the method by Lobo.

Claim 17 further adds a combination of two or more steps of: a) collecting data, b) training of the classifier using cross-validation, c) bootstrapping to obtain the best classifier, and d) testing the classifier for the step of utilizing a plurality of classifiers.

In the applicants’ patent, the gray-scale pixel values of the face image or the algebraically manipulated face image is directly used for classification (Applicants, page 8, lines 9-12). In order to directly use the multi-dimensional image data or the algebraically transformed image data, sophisticated algorithms have to be used as mentioned in the patent on (Applicants, page 8,

lines 16-19). Thus the classifier training is very involved and explained in (Applicants, page 9, lines 1-8). In Lobo, however, one dimensional data in the form of ratios are used and hence the classification step involves simple thresholding as discussed in Lobo (Lobo, column 19, lines 32-47). The methodology as explained in Lobo involved a simple threshold selection for the ratios for different age categories and the wrinkle pattern test to distinguish seniors for age classification. Thus the classifier training stage in Lobo is a simple thresholding process and very different from the methodology employed in the applicants' current invention, which is designed for a multi-dimensional classifier.

Claim 18 further adds a step of arranging a plurality of classifiers in serial as explained in (Applicants, page 9, lines 1-8). In Lobo, six different types of ratios were tested for age classification and in (Lobo, column 23, lines 42-48) it is mentioned that depending on the case such as "face rotated in depth", different ratios could be used. Combination of multiple ratios by statistical analysis is also mentioned in Lobo. It is, however, not explicitly stated how there is a possibility of using multiple classifiers and how those classifiers could be used in serial combination.

Claim 19 further adds a step of ordering of the classifiers so that the coarse classification takes place first followed by the fine age classification as explained in (Applicants, page 9, lines 1-8). In Lobo, six different types of ratios were tested for age classification and in (Lobo, column 23, lines 42-48) it is mentioned that depending on the case such as "face rotated in depth", different ratios could be used. Combination of multiple ratios by statistical analysis is also mentioned in

Lobo. However, in Lobo, it is not explicitly shown how it is possible to use multiple classifiers and order the classifiers when used in a series setup.

Claim 20 further adds a step of arranging a plurality of classifiers in parallel as explained in (Applicants, page 9, lines 1-8). In Lobo, six different types of ratios were tested for age classification and in (Lobo, column 23, lines 42-48) it is mentioned that depending on the case such as “face rotated in depth”, different ratios could be used. Combination of multiple ratios by statistical analysis is also mentioned in Lobo. However, in Lobo, it is not explicitly shown how it is possible to use multiple classifiers in parallel.

Claim 21 further adds a step of arranging the plurality of classifiers in a combination of serial and parallel configurations as explained in (Applicants, page 9, lines 1-8). In Lobo, six different types of ratios were tested for age classification and in (Lobo, column 23, lines 42-48) it is mentioned that depending on the case such as “face rotated in depth”, different ratios could be used. Combination of multiple ratios by statistical analysis is also mentioned in Lobo. However, in Lobo it is not explicitly shown how it is possible to have a plurality of classifiers and how to arrange the plurality of classifiers in a combination of serial and parallel configurations.

Accordingly applicants submit that the dependent claims are a fortiori patentable and should also be allowed.

Newly Added Apparatus Claims

In addition, applicants request consideration of new claims 22-30 for the same reasons as stated above with respect to claims 13-21. The apparatus claims 22-30 recite limitations that are similar and in the same scope of invention as to those in claims 13-21, respectively.

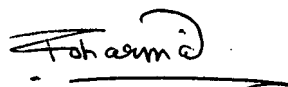
CONCLUSION

For all the above reasons, applicants submit that the specification and claims are now in proper form, and that the claims all define patentably over the prior art. Therefore they submit that this application is in condition for allowance now, which action they respectfully solicit.

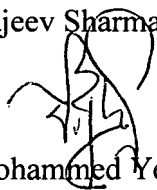
Conditional Request for Constructive Assistance

Applicants have amended the specification and claims of this application so that they are proper, definite, and define novel structure, which is also unobvious. If, for any reason this application is not believed to be in full condition for allowance, applicants **very respectfully request** the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. § 2173.02 and § 707.07(j) in order that the undersigned can place this application in allowable condition.

Very respectfully,



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